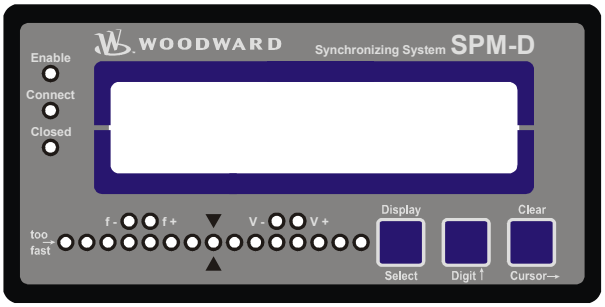
37231D

SPM-D10B/PSY5
Synchronizing Unit



Manual
Version 1.1xx

Manual 37231D

WARNING

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

The engine, turbine, or other type of prime mover should be equipped with an overspeed (overtemperature, or overpressure, where applicable) shutdown device(s), that operates totally independently of the prime mover control device(s) to protect against runaway or damage to the engine, turbine, or other type of prime mover with possible personal injury or loss of life should the mechanical-hydraulic governor(s) or electric control(s), the actuator(s), fuel control(s), the driving mechanism(s), the linkage(s), or the controlled device(s) fail.

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

CAUTION

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts.

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

OUT-OF-DATE PUBLICATION

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Important definitions

WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment.

NOTE

Provides other helpful information that does not fall under the warning or caution categories.

Revision History

Rev.	Date	Editor	Changes
C	08-11-14	TP	Release
D	2014-09-23	GG	Voltage range changed from “90 to 250 Vac/dc” to “90 to 250 Vac”. Protection (from back) changed from “IP21” to “IP20”.

Content

Illustrations and Tables

Illustrations

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Chapter 1.
General Information

Intended Use The unit must only be operated for the uses described in this manual. The prerequisite for a proper and safe operation of the product is correct transportation, storage, and installation as well as careful operation and maintenance.

NOTE

This manual has been developed for a unit fitted with all available options. Inputs/outputs, functions, configuration screens and other details described, which do not exist on your unit may be ignored.

The present manual has been prepared to enable the installation and commissioning of the unit. On account of the large variety of parameter settings, it is not possible to cover every possible combination. The manual are therefore only a guide. In case of incorrect entries or a total loss of functions, the default settings can be taken from the enclosed list of parameters.

Chapter 2.
Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as easily as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, etc.) away from the control, modules, and work area as much as possible.

4. **Opening the control cover may void the unit warranty.**
   Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

   - Ensure that the device is completely voltage-free (all connectors have to be disconnected).
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, connectors, or components with conductive devices or with bare hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

NOTE

The unit is capable to withstand an electrostatic powder coating process with a voltage of up to 85 kV and a current of up to 40 µA.

Chapter 3.
Installation

CAUTION

A circuit breaker must be provided near to the unit and in a position easily accessible to the operator. This must also bear a sign identifying it as an isolating switch for the unit.

NOTE

Inductivities connected (such as coils of operating current or undervoltage tripping units, or auxiliary or power contacts) must be connected to a suitable interference suppressor.

Wiring diagram

SPM-D10B/PSY5-FU-D (power supply: 24 Vdc)

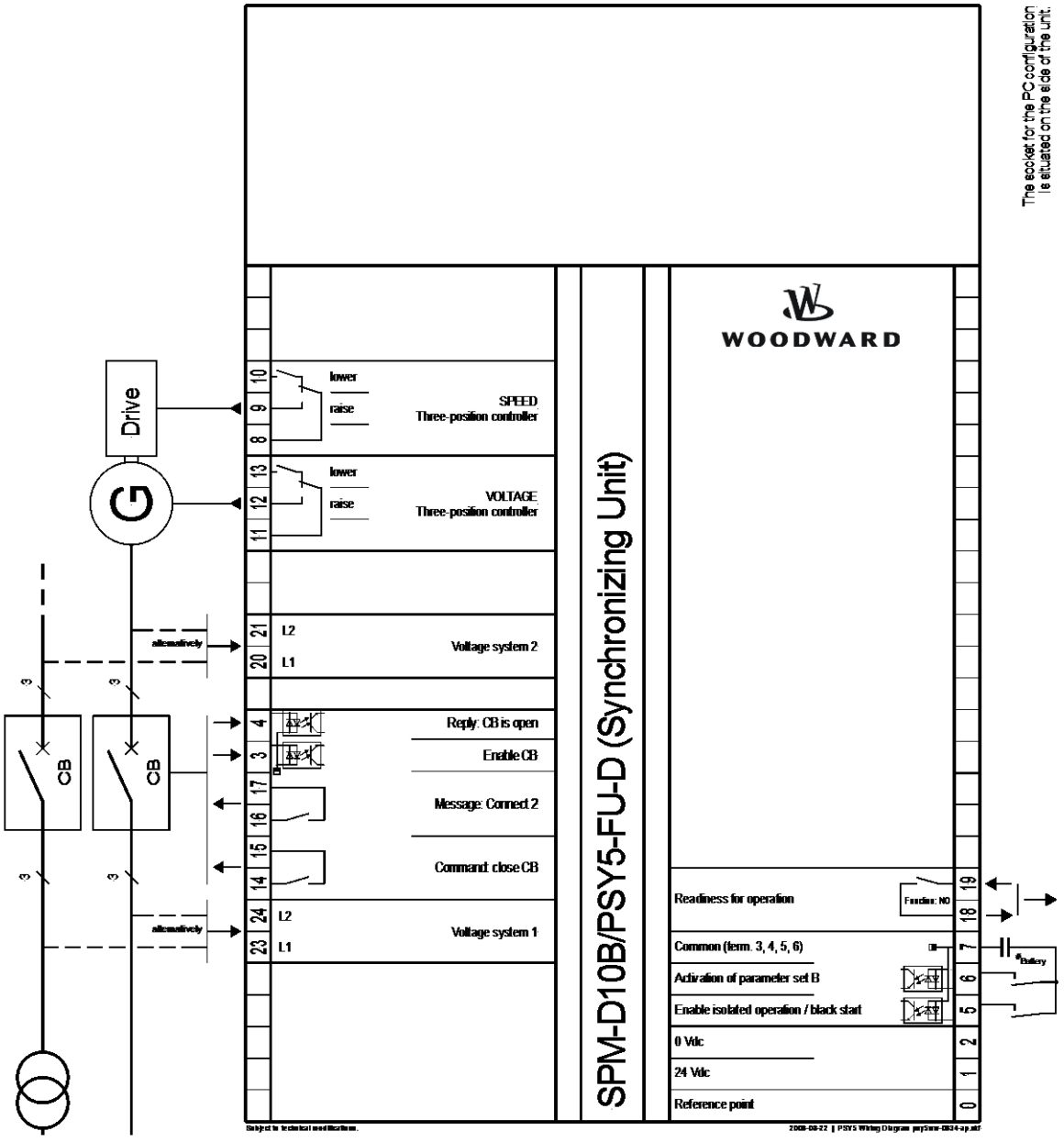

Figure 3-1: Wiring diagram SPM-D10B/PSY5-FU-D

SPM-D10B/PSY5-FU-A (power supply: 24 Vdc)

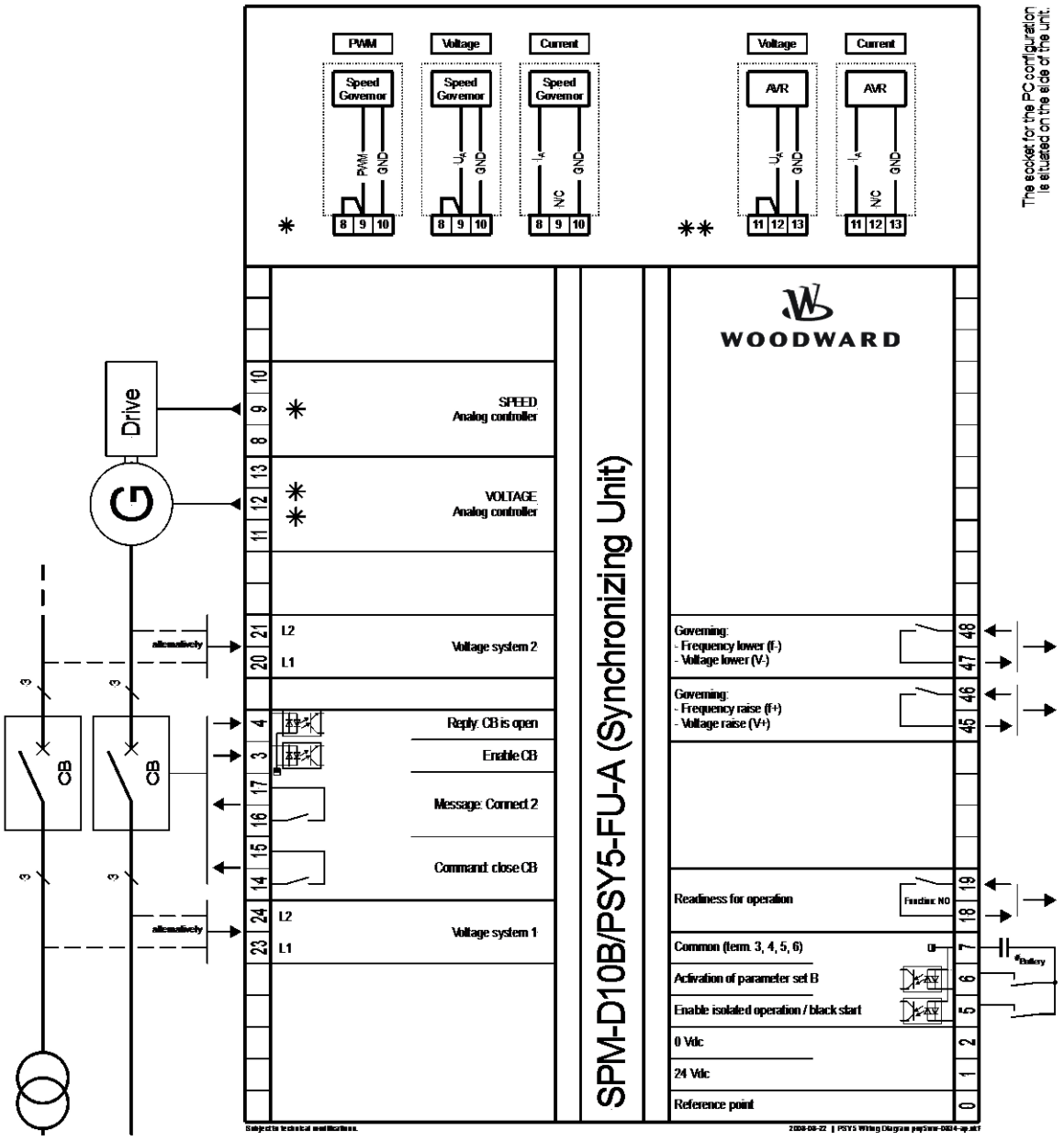

Figure 3-2: Wiring diagram SPM-D10B/PSY5-FU-A

SPM-D10B/PSY5-FU-D-W (power supply: 90..250 Vac)

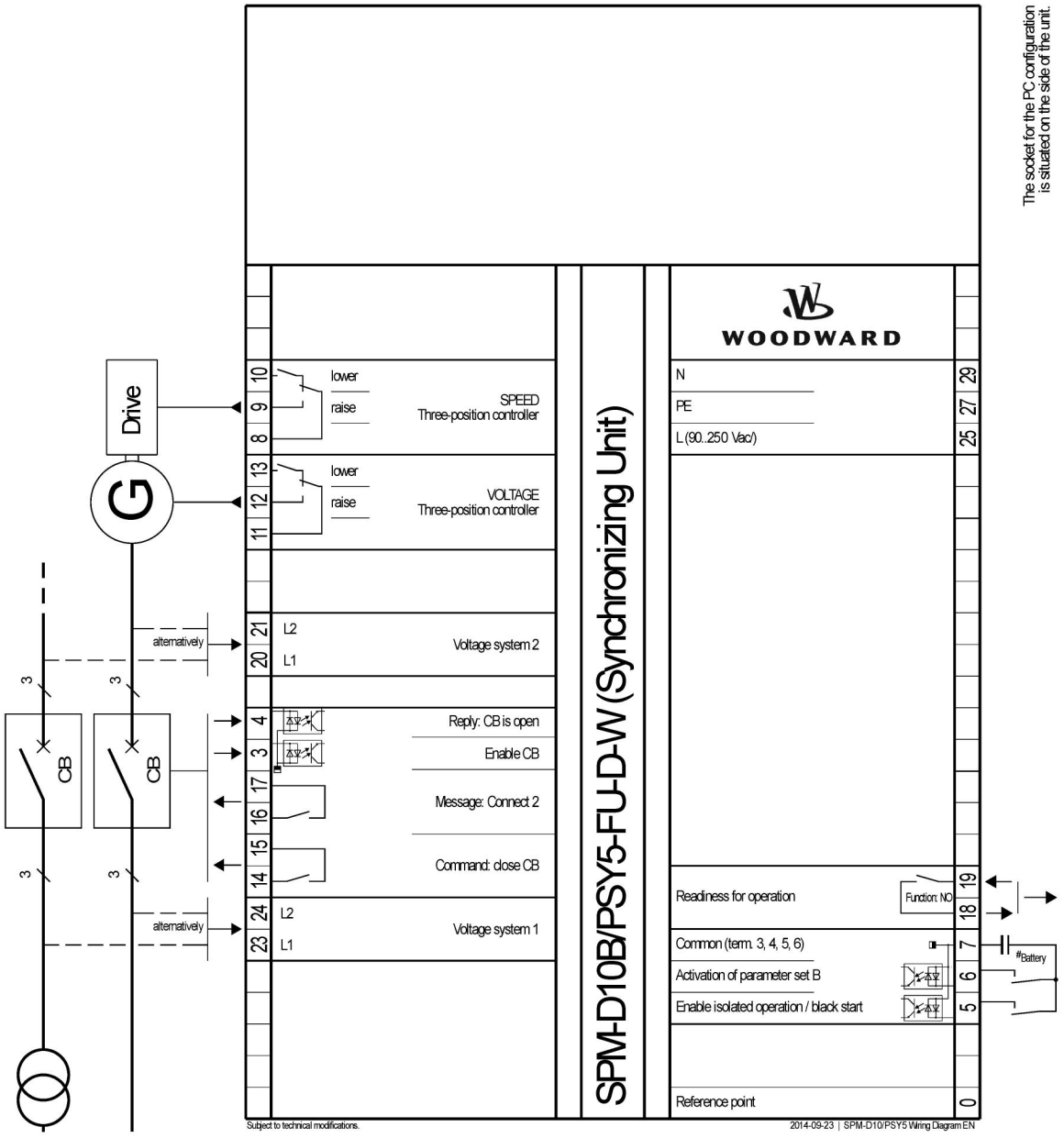

Figure 3-3: Wiring diagram SPM-D10B/PSY5-FU-D-W

SPM-D10B/PSY5-FU-A-W (power supply: 90..250 Vac)

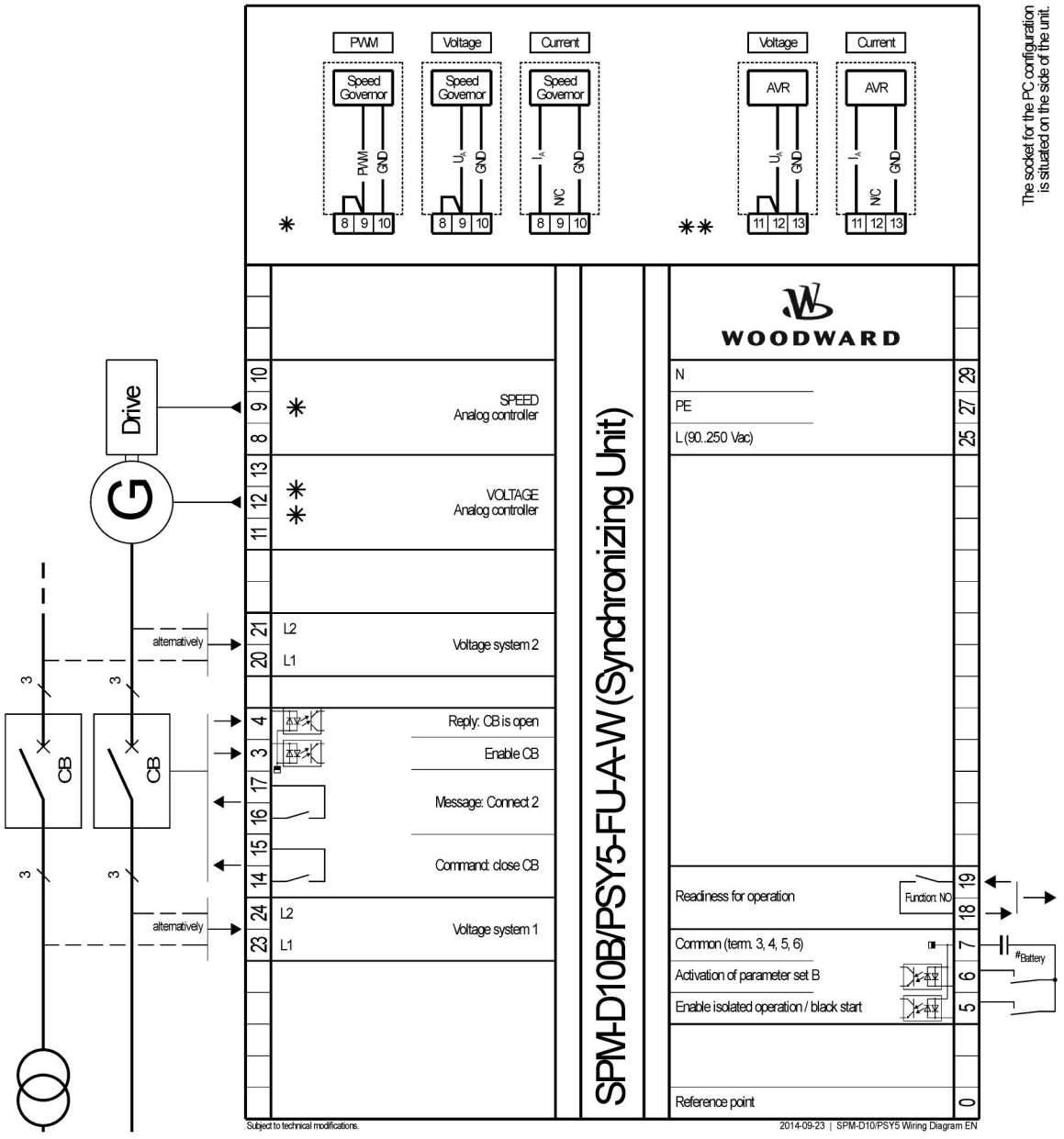

Figure 3-4: Wiring diagram SPM-D10B/PSY5-FU-A-W

Reference point

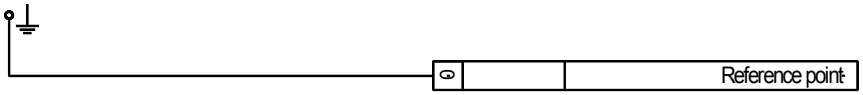

Figure 3-5: Reference point

Terminal	Description	A_{max}
0	Reference point: Neutral point of the three-phase system or neutral terminal of the voltage transformer (Measuring reference point); → with three-conductor systems, do not connect	Sold.lug

Power supply (standard & SPM-D10B/PSY5-..W)

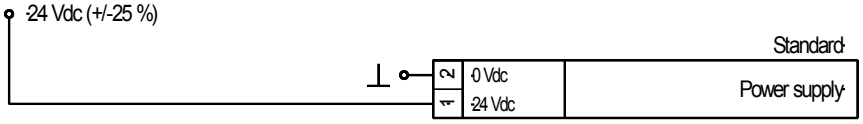

Figure 3-6: Power supply (24 Vdc, standard)

Terminal	Description	A_{max}
Standard		
1	+24 Vdc, 10 W	2.5 mm²
2	0 V reference potential	2.5 mm²

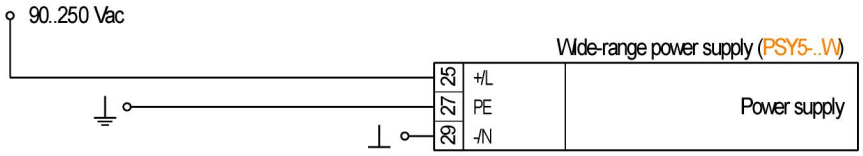

Figure 3-7: Power supply (90..250 Vac, SPM-D10B/PSY5-..W)

Terminal	Description	A_{max}
SPM-D10B/PSY5-..W - wide range power supply		
25	90..250 Vac, max. 10 VA	2.5 mm²
27	PE	2.5 mm²
29	0 Vac	2.5 mm²

Measuring inputs

NOTE

The SPM-D10B/PSY5 can operate (monitor) only one synchronization point (one power circuit breaker), because it is a 1-power-circuit-breaker configuration. The voltage at terminals 23/24 (system 1) is the voltage to which the assessment of the synchronization at terminals 20/21 (system 2) refers. The synchronization voltage can be, e. g., the mains or busbar voltage.

NOTE

There are generally three different variants for connection of the measuring circuit voltage:

① Direct connection to the low voltage system,
② Connection to medium voltage via two-pole isolated transformer (e. g. in the case of a V-connection) and
③ Connection to medium voltage via single-pole isolated transformer (e. g. Y-connection).

System 2

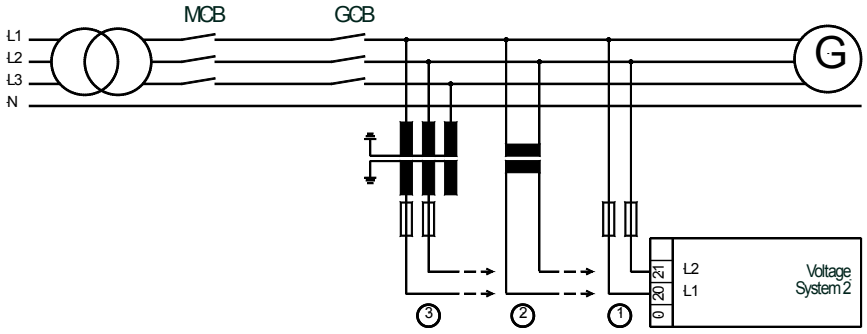

Figure 3-8: Measuring inputs – voltage system 2

Note: Connection corresponding to the mains configuration (see wiring diagram).

Terminal	Measurement	Description	A_{max}
Connection to the measuring circuit voltage corresponding to the variant ①, ② or ③			
20	direct or Transformer ../100 V	Voltage system 2 - L1	2.5 mm²
21		Voltage system 2 - L2	2.5 mm²
0		Reference point: N-terminal of the low voltage system or star point of the voltage transducer (measuring reference point); → do not connect in three wire installations	Sold.lug

System 1

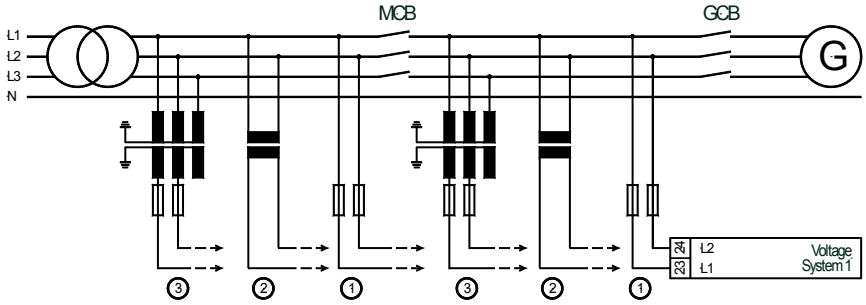

Figure 3-9: Measuring inputs – Voltage system 1

Note: Connection corresponding to the mains configuration (see wiring diagram).

Terminal	Measurement	Description	A_{max}
Connection to the measuring circuit voltage corresponding to variant ①, ② or ③			
23	direct	Voltage system 1 - L1	2.5 mm²
24	or ../100 V	Voltage system 1 - L2	2.5 mm²

Discrete inputs

CAUTION

Please note that the maximum voltages which may be applied at the discrete inputs are defined as follows. Voltages higher than those specified destroy the hardware!

- **Maximum input range: +/-18..250 Vac.**

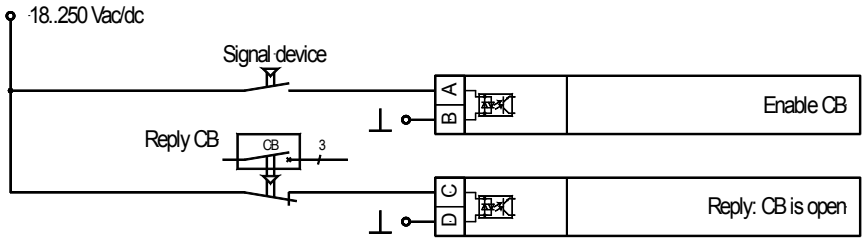

Figure 3-10: Discrete inputs

Terminal	Associated zero-terminal	Description (acc. DIN 40 719 part 3, 5.8.3)	A_{max}
Make contact			
A	***B***		
3	7	Enable CB	2.5 mm²
5		Enable isolated operation / black start	2.5 mm²
6		Activation of parameter set B	2.5 mm²
Normally closed contact			
C	***D***		
4	7	Reply: CB is open	2.5 mm²

Relay outputs

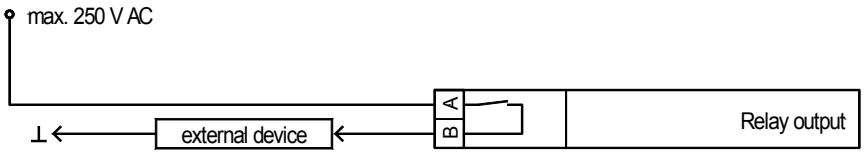

Figure 3-11: Relay outputs – control outputs I (CB control)

Root ***A***	Switched ***B***	Description	A_{max}
14	15	Synchronizing pulse, Command: close CB	2.5 mm²

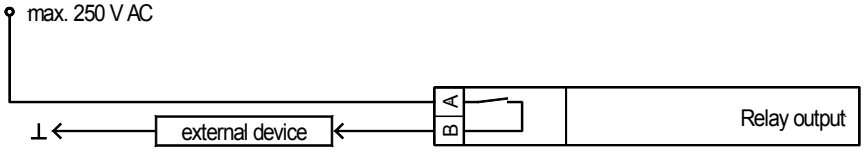

Figure 3-12: Relay outputs – control outputs II (messages)

Root ***A***	Switched ***B***	Description **Note:** The relays close when the function is fulfilled.	A_{max}
16	17	Message: Connect 2	2.5 mm²
18	19	Readiness for operation	2.5 mm²

Controller outputs

The SPM-D10B/PSY5-FU-D.. is equipped with two three-position controllers for voltage and frequency (made of a form C and form A relay). With the version SPM-D10B/PSY5-FU-A different controller output signals can be selected by configuration, which are connected in different ways.

SPM-D10B/PSY5-..D..

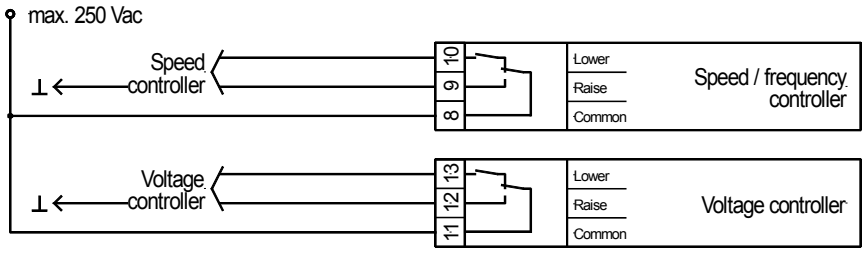

Figure 3-13: Controller - SPM-D10B/PSY5-..D.. – three position controller

Terminal		Description	A_{max}
8	common	Speed/frequency controller	2.5 mm²
9	higher		2.5 mm²
10	lower		2.5 mm²
11	common	Voltage controller	2.5 mm²
12	higher		2.5 mm²
13	lower		2.5 mm²

SPM-D10B/PSY5-..A..

The SPM-D10B/PSY5-..A.. has controller outputs for the following signals which can be changed by configuration as well as over an external bridge.

Versions

- **Three-position controller** via relay manager
  - Control of n/f: Parameter "**f-controller type**" = THREESTEP
    n+/f+ = Relay connected to terminals 45/46
    n-/f- = Relay connected to terminals 47/48
  - Control of V: parameter "**v-controller type**" = THREESTEP
    V+ = Relay connected to terminals 45/46
    V- = Relay connected to terminals 47/48

- **Analog controller output**
  - Control of n/f: Parameter "**f-controller type**" = ANALOG
    Current output (mA) = no external bridge/jumper necessary
    Voltage output (V) = external bridge/jumper between 8/9
    Connect the Controller to terminals 9/10
  - Control of V: Parameter "**v-controller type**" = ANALOG
    Current output (mA) = no external bridge/jumper necessary
    Voltage output (V) = external bridge/jumper between 11/12
    Connect the controller to terminals 12/13

- **PWM controller output**
  - Control of n/f: Parameter "**f-controller type**" = PWM
    PWM output = external bridge/jumper between 8/9
    Connect the controller to terminals 9/10

Connection of the controllers

Setting: 'THREESTEP' (three-position controller)

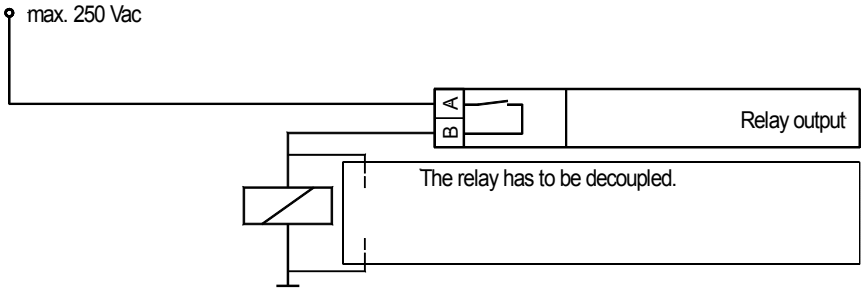

Figure 3-14: Controller - SPM-D10B/PSY5-..A.. – three position controller

Terminal		Description	A_{max}
45	raise	Speed / Frequency controller or Voltage controller	2.5 mm²
46			2.5 mm²
47	lower		2.5 mm²
48			2.5 mm²

NOTE

In the SPM-D10B/PSY5-FU-A-W no relays for three-point controller are present!

Setting: 'ANALOG' and 'PWM' (analog controller) – Frequency controller

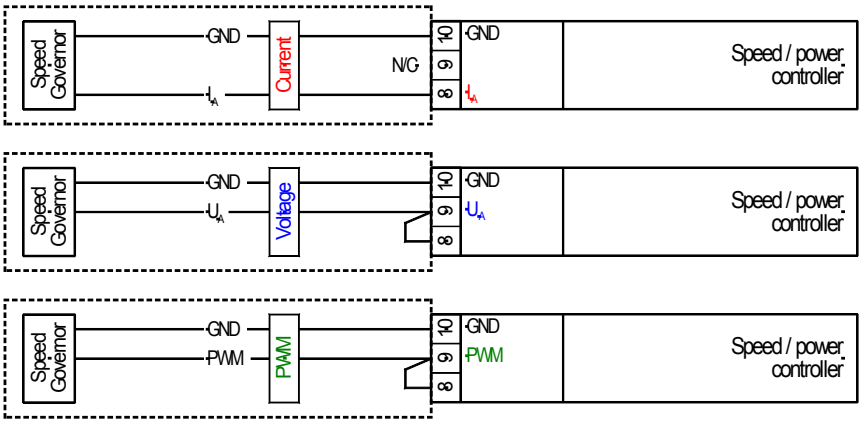

Figure 3-15: Controller - SPM-D10B/PSY5-..A.. – analog controller output - speed/frequency

Type	Terminal		Description	A_{max}
I Current	8	I_A	Speed controller / Frequency controller	2,5 mm²
	9			2,5 mm²
	10	GND		2,5 mm²
U Voltage	8			2,5 mm²
	9	U_A		2,5 mm²
	10	GND		2,5 mm²
PWM	8			2,5 mm²
	9	PWM		2,5 mm²
	10	GND		2,5 mm²

Setting: 'ANALOG' (analog controller) – voltage controller

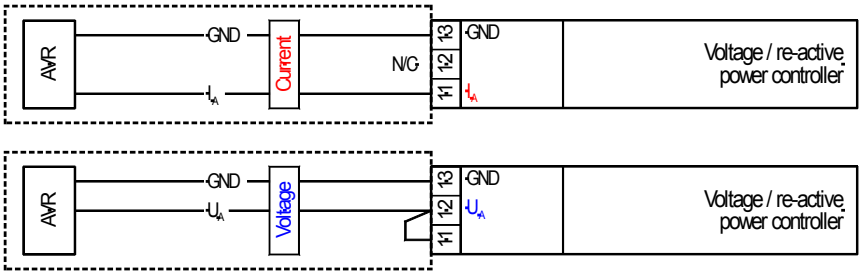

Figure 3-16: Controller - SPM-D10B/PSY5-..A.. – analog controller output - voltage

Type	Terminal		Description	A_{max}
I Current	11	I_A	Voltage controller	2.5 mm²
	12			2.5 mm²
	13	GND		2.5 mm²
U Voltage	11			2.5 mm²
	12	U_A		2.5 mm²
	13	GND		2.5 mm²

Chapter 4.
Description of Functions

Functionality

Function tables

The status of the discrete inputs "Reply: CB open" and "Enable CB" is displayed via the LEDs "Closed" und "Enable" on the pressure-sensitive front membrane. Additionally to the input signals the conditions in Table 4-2: Operating conditions - terms must be noticed.

Input signal			Operating condition	Cond.	Relay "Command: close CB"
LED "Closed"	**LED** "Enable"	**Discr. inp. term. 5**: "Enable isolated op. / Blackstart"			
0	0	x	OFF or automatic no-load control	- C1	OFF OFF
0	1	0	No-load operation or synchronization or synch-check	C A A1	OFF Slip or phase zero Synch-check
0	1	1	No-load operation or synchronization or Synch-check or Black start	C A A1 B	OFF Slip or phase zero Synch-check Black start
1	x	0	OFF	-	OFF
1	x	1	Isolated operation	D	OFF

0: "OFF" / 1: "ON" / x: Signal of no significance (0 or 1)

Table 4-1: Operating conditions

Additional conditions

The function of the unit is also dependent, apart from the discrete input signals, on the state of the available measured voltages. The particular function must also be activated in configuration mode:

Condition		
A	Synchronization	- Voltage of system 1 and system 2 must apply to the following conditions: 50 % < U < 125 % of the rated voltage V_N 80 % < f < 110 % of the rated frequency f_N (after time monitoring trips, the synchronization will be aborted)
A1	Synch-check	- Voltage of system 1 and system 2 must apply to the following conditions: 50 % < U < 125 % of the rated voltage V_N 80 % < f < 110 % of the rated frequency f_N
B	Blackstart	- Parameter "black start gen. switch ON" - One of the three black start options must be switched on and the voltages U1 and U2 must be within the configured limits for the black start
C1	Automatic no-load control	- Parameter "Automatic no-load control ON" - The frequency controller applies to the following conditions: Voltage of system 2 > 50 % of the rated voltage V_N - The voltage controller applies to the following conditions: Frequency of system 2 > 90 % of the rated frequency f_N
C	No-load operation	- for f control: Voltage of system 2 > 50 % of rated voltage V_N - for V control: Frequency of system 2 > 90 % of rated frequency V_N
D	Isolated operation	- Voltage of system 2 > 50 % of rated voltage V_N - For voltage controller: Parameter "Voltage controller in no-load operation ON" - For frequency controller: Parameter "Frequency controller in isolated operation ON".

Table 4-2: Operating conditions - terms

Control inputs

Enable CB
Terminal 3

If this discrete input is set, the operation of the power circuit breaker and the control functions are enabled at the same time, if this input is set. If the power circuit breaker is closed, this input has no effect.

Reply: CB is open
Terminal 4

The status of the CB must be transmitted to this unit through this input. The input must be set if the CB is open. (The status of this input is checked for its plausibility and is signaled with the LED "Closed".)

Enable: Isolated operation/black start
Terminal 5

With an opened power circuit breaker a black start is enabled, by setting this input. With a closed power circuit breaker the frequency and voltage controllers are enabled for isolated operation, by setting this input.

Activation of set of parameters B
Terminal 6

With this discrete input you can switch between the two parameter sets A and B. If this discrete input is set the unit works with parameter set B, otherwise with parameter set A. One set of parameters includes the parameters

three-position controller: gain, time pulse, and insensitivity
analog controller: gain, reset time, derivative-action time

of the frequency and voltage controller and of the actual synchronization the pull-in time of the switch.

Isolation of the power supply from the discrete inputs

By means of an appropriate external wiring, the common reference point of the discrete inputs (terminal 7) can be metallically separated from the supply voltage (0 V, terminal 2) . This is for instance necessary, if the discrete inputs are not to be controlled with +24 Vdc and a metallic separation of the control voltage (e. g. 220 Vdc, 220 Vac) from the supply voltage has to be ensured.

Wiring should be made as follows:

- Reference points connected with 0 V
  Bridge between terminal 7 and terminal 2 (0 V)
- Reference point of the discrete inputs potential-free:
  Terminal 2: 0 V (supply voltage)
  Terminal 7: 0 V or N (control voltage)

Operating conditions

No load control

The voltage and frequency of system 2 are adjusted to the configured setpoint values. The generator circuit breaker is open.

Synchronizing

Synchronization with slip

The voltage of system 2 will be corrected to the amplitude and frequency of the voltage of system 1, if the controller are set ON in configuration mode. In consideration of the inherent delay the connect command for the power circuit breaker will be issued. The synchronization is done under the following conditions (see also tables in chapter "Function tables" at page 21):

- The unit is in the automatic mode (double voltage / frequency display).
- The synchronization is switched on.
- The voltages and frequencies are within a certain range.
- The input "Enable CB" is set.
- The input "Reply: CB is open" is set and
- the synchronization time monitoring is not switched on or has not tripped.

Synchronization with zero phase control

The voltage of system 2 will be corrected to the amplitude of the voltage of system 1 by the voltage controller. The frequency controller is operating in two possible stages:

- Frequency correction: - As long as the difference of the frequency between system 2 and system 1 does not fall below the configured value "df start", the system 2 is corrected to the frequency of system 1.
- Phase angle correction: - If the frequency difference between system 2 and system 1 is less than the value "df start", the frequency controller adjusts the phase angle of system 2 to that of system 1, in view of turning the phase difference to zero. The control of the phase angle is stopped only, when the frequency difference between system 2 and system 1 is getting greater then the value "df start" plus a firmly deposited hysteresis of 0.8 Hz.

The controller can be switched off in configuration mode, if the switch-on shall occur without control.

The connect command for the power circuit breaker is done under the following conditions:

- The configured limits for voltage and frequency are met.
- The phase angle between the systems is less then the maximal permissible angle for at least the configurable time
- The input "Enable CB" is set.
- The input "Reply CB is open" is set

The connection is done without consideration of the inherent delay. In the phase-angle-zero-control mode the analog input should be selected for the frequency controller.

Synch check

In this condition, the unit can be used as a synchronization control. No control is carried out. The relay "CB close" remains picked up, as long as the following conditions are met:

- The parameter „Synch check mode“ is set ON.
- The configured limit for the voltage difference is met (screen "synchronization dV_{max})
- The configured limits for the frequency difference are met (screens "synchronization df_{max} and df_{min}")
- The configured limit for the phase angle is met (screen "slip synchron. phi_{max}")
- The input "Reply: CB is open" is set
- the input "Enable CB" is set.

The synchronization time monitoring is deactivated.

Isolated operation

Frequency and voltage of system 2 will be adjusted to the configurable setpoint values. The circuit breaker is closed. To activate the voltage controller, the parameter "voltage controller in isolated operation" must be set to "ON". To activate the frequency controller, the parameter "frequency controller in isolated operation" must be set to "ON". More over, isolated operation is only possible, if the discrete input "Release isolated operation / black start" is set.

Closing the CB without synchronization (black start)

Output of a connect command for the power circuit breaker without synchronization if the following conditions are met:

- The black start function is in principle activated by configuration,
- one of the three possible black start functions is selected by configuration,
- the discrete input "Black start release" is set,
- the discrete input "Release CB" is set,
- the discrete input "Release CB" is set,
- the conditions for one of the preset black start functions are fulfilled:
  a) U1 has the value Un (taking the configured rated voltage difference into account dU |U-Un|) and U2 is zero (taking the configured zero voltage difference into account dU |U-0|).
  b) U1 is zero (taking the configured zero voltage difference into account dU |U-0|) and U2 has the value Un (taking the configured rated voltage difference into account dU |U-Un|).
  c) U1 is zero and U2 is zero (taking each configured zero voltage difference into account dU |U-0|).

Moreover, in case a) and b) the frequency of U1 and U2 must be within the configured limits.

LED "Closed" flashes

LED "Closed" flashes: Incorrect signal state of the "Reply: CB is open" on terminal 4.
Possible faults:

- Reply present on (= 0 V)
  system 1 and system 2 not synchronous

If the LED flashes, one must check to see whether the input on terminal 4 is correctly wired. For the wiring to be correct, there must be **0 V** applied to the input when the **power circuit breaker is closed**.

Control outputs

Synchronization pulse: Command: Close CB
Terminals 14/15

By setting this relay the CB will be closed. The relay drops out after the pulse is output. Exception: Operation mode Synch-check.

"Message: Connect 2"
Terminal 16/17

For the description of these control inputs please refer to chapter "Relay output 16-17" on page 55

Readiness for operation
Terminals 18/19

The contact assembly is closed when the unit is ready for operation. The relay will drop out if the following occurs:

a) The internal self-monitoring system stated an alarm. In this case a trouble-free function of the unit cannot be guaranteed and other appropriate measures have to be taken into account, if necessary.
b) The synchronization time monitoring system is activated and has responded.

Analog controller outputs

The analog PID controller forms a closed-loop control loop together with the controlled system (usually a first-order lag element). The parameters of the PID controller (proportional-action coefficient K_P, derivative-action time T_V and reset time T_n) can be modified individually.

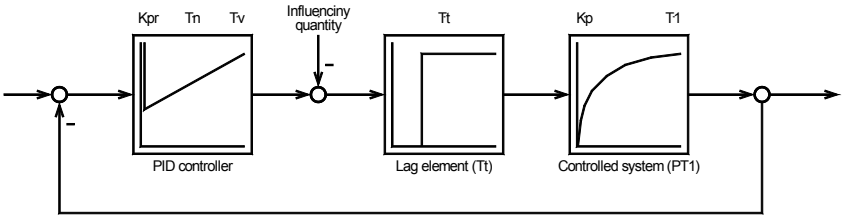

Figure 4-1: Control loop

If an abrupt disturbance variable is applied to the control loop, the reaction of the controlled system can be recorded at the output as a function of time (step response).

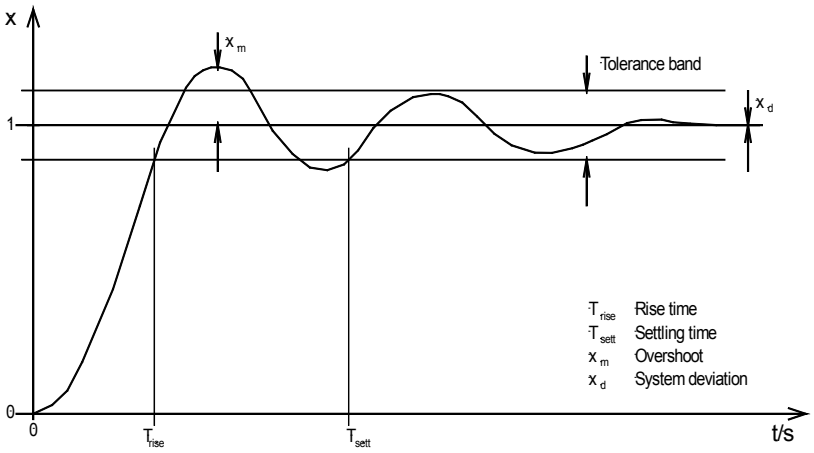

Figure 4-2: Step response (example)

Various values can be obtained from the step response; these are required for adjusting the controller to its optimum setting:

Rise time T_{an}: Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a jump in the disturbance variable or reference input variable and ending the first time the value re-enters this range.

Setting time T_{aus}: Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a step in the disturbance variable or reference input variable and ending when the value re-enters this range permanently.

Overshoot x_m: Highest transient setpoint value deviation during the transition from one steady-state condition to a new steady-state condition following modification of the disturbance variable or reference input variable ($x_{m\ Optimal} \leq 10$ %).

Permanent control deviation x_d: The present deviation between setpoint value and control variable in the steady-state condition (PID controller: $x_d = 0$).

From these values, the values K_P, T_n and T_V can be determined by various calculations. Moreover, it is possible, by performing various calculations, to determine the optimal controller settings, e. g. by calculating compensation or adjustment of the time constants, T-sum rule, or symmetric optimum. Other setting procedures and information may be obtained from current literature.

CAUTION

The following must be observed regarding the controller setting:

- **Ensure that the emergency shutdown system is ready for use.**
- **While determining the critical frequency, pay attention to the amplitude and frequency.**
- **If the two values change uncontrollably:**

➔ EMERGENCY SHUTDOWN ←

Initial state: The start position of the controller is determined using the initial state of the controller. If the controller is switched off, the initial state can be used to output a fixed controller position. Even when the analog controller is switched off, the initial state can be freely adjusted (e.g. the speed controller can be controlled in a statically manner).

```
Controller output
Initial state 000%
```

Initial state **0..100 %**

Analog controller output setting with controller switched off.

General settings: The setting rule described below only serves as an example. Whether this method is suitable for setting your particular controlled system has not been and cannot be taken into account as each controlled system behaves uniquely.

There are various methods of setting a controller. The setting rules of Ziegler and Nichols are explained below (determination for abrupt disturbances on the system input); this setting method assumes a pure lag element connected in series with a first-order lag system.

1. Controller operated as a P-only controller
   (where $T_n = \infty$ [screen setting: $T_n = 0$], $T_V = 0$).
2. Increase gain K_P (P gain) until the control loop oscillates continuously at $K_P = K_{Pcrit}$.

CAUTION

If the unit starts to oscillate uncontrollably, carry out an emergency shutdown and alter the screen setting accordingly.

3. Measuring of the cycle duration T_{crit}
4. Set the parameters:

PID controller

$K_P = 0{,}6 \times K_{Pkrit}$
$T_n = 0{,}5 \times T_{krit}$
$T_V = 0{,}125 \times T_{krit}$

PI controller

$K_P = 0{,}45 \times K_{Pkrit}$
$T_n = 0{,}83 \times T_{krit}$

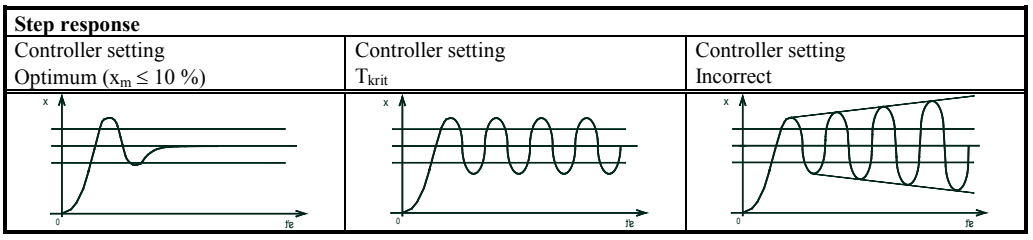

Figure 4-3: Step response – controller set-up

```
Pr.-sensitivity
        Kp=000
```

P gain (K_{PR}) Proportional-action coefficient **1..240**

The proportional-action coefficient K_P indicates the closed-loop control system gain. The variable to be controlled is achieved more rapidly by increasing the P-gain.

```
Reset time
     Tn = 00,0s
```

Reset time (T_n) **0.2..60.0 s**

The reset time T_n belongs to the I-part of the PID controller. The I-component results in permanent control deviation being eliminated in the controlled state.

```
Derivative act.
time    Tv=0.00s
```

Derivative-action time (T_V) **0.00..6.00 s**

The derivative-action time T_V belongs to the D-part of the PID controller. An increase in the phase reserve (stability) and the attenuation results from increasing this parameter.

Chapter 5.
Display and Operating Elements

The foil of the front plate is made of coated plastics. All keys have been designed as touch-sensitive membrane switch elements. The display is a LC-display, consisting of 2 × 16 characters, which are indirectly illuminated red. Contrast of the display is infinitely variable by a rotary potentiometer at the left side.

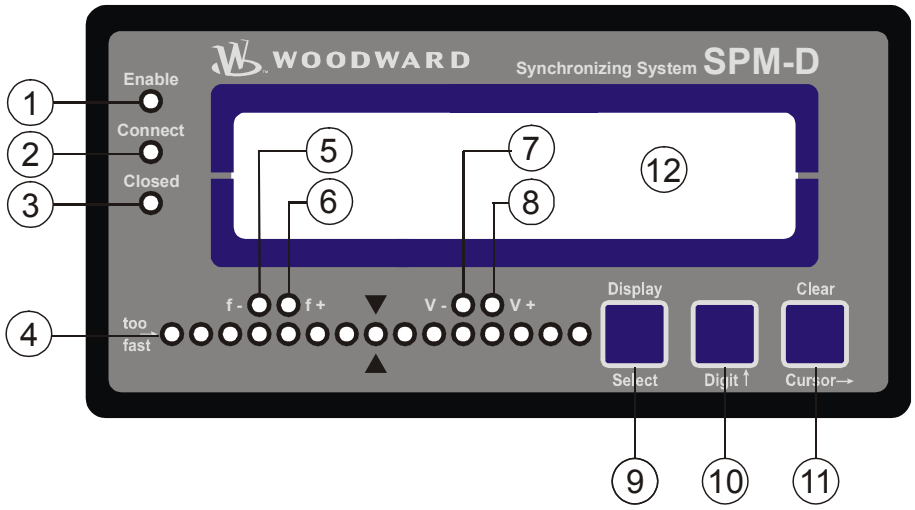

Figure 5-1: Front foil

Brief explanation of the LEDs and push buttons

LEDs

No	Description	Function
1	Enable	Enable CB
2	Connect	Close command to the CB issued
3	Closed	Reply: CB is closed
4	Synchroscope	Display of phase position
5	f-	Governor output: frequency lower (reduce speed)
6	f+	Governor output: frequency raise (increase speed)
7	V-	Governor output: voltage lower (reduce excitation)
8	V+	Governor output: voltage raise (increase excitation)

Buttons

No	Description	Function
9	Display	Advance display
9	Select	Confirm selection
10	Digit	Increase digit
11	Clear	Acknowledge alarm
11	Cursor	Shift input position one digit to the right

Others

No	Description	Function
12	LC-Display	LC-Display
	Potentiometer	Adjust LCD contrast

LEDs

1 **Enable**
Color: green

Enable power circuit breaker

The LED " Enable" indicates that the power circuit breaker has been enabled for operation. The status of the LED corresponds to the status of the discrete input "Enable CB".

2 **Connect**
Color: green

CB close

Die LED "Connect" lights up when the unit outputs an add-on order to the power circuit breaker. The status of the LED corresponds to the status of the relay "synchronizing pulse command: close CB.

3 **Closed**
Color: green

Power circuit breaker ON

The LED "Closed" signals the response of the power circuit breaker. The LED lights up if the discrete input "Reply: CB is open" is not set and will extinguish as soon as the discrete input is set. (see also chapter "LED "Closed" flashes" on page 26).

4 LED-row:
Color: red/yellow/green

Phase position / synchroscope

The row of LEDs indicates the current phase position between the two voltages indicated on the display. The green LED in the middle of the 15 LEDs indicates that the measured phase angle between the voltage systems is less than 12 ° electrical. The phase position is only displayed in the automatic mode and only, if the difference between the frequency values is smaller than 2 Hz and both voltages are within the specified permissible ranges. These ranges are defined as follows:

Frequency ranges 80..110 % f_N
Voltage ranges 50..125 % U_N

There are two different directions of rotation:
left → right..If the LED's run from left to right, the frequency of system 2 is too high, i. e., the system 2 turns too rapidly;
right → left..If the LED's run from right to left, the frequency of system 2 is too low, i. e., the system 2 turns too slowly.

5 **f-** Color: yellow — **Governor output reduce frequency**

Three position controller The LED "f-" indicates if the unit outputs a pulse to decrease the frequency. The status of the LED corresponds to the status of the relay "speed lower".

Analog controller If the actuating signal of the controller is changing to reduce the frequency, the LED illuminates.

6 **f+** Color: yellow — **Governor output increase frequency**

Three position controller r The LED "f+" indicates if the unit outputs a pulse to increase the frequency. The status of the LED corresponds to the status of the relay "speed raise".

Analog controller If the actuating signal of the controller is changing to increase the frequency, the LED illuminates.

7 **V-** Color: yellow — **Governor output reduce voltage**

Three-position controller The LED "V-" indicates if the unit outputs a pulse to decrease voltage. The status of the LED corresponds to the status of the relay "voltage lower".

Analog controller If the actuating signal of the controller is changing to reduce the voltage, the LED illuminates.

8 **V+** Color: yellow — **Governor output increase voltage**

Three-position controller r The LED "V+" indicates if the unit outputs a pulse to increase voltage. The status of the LED corresponds to the status of the relay "voltage raise".

Analog controller r If the actuating signal of the controller is changing to increase the voltage, the LED illuminates.

Push buttons

In order to facilitate the setting of the parameters the buttons are equipped with a "AUTOROLL-function". It allows to switch to the next setting and configuration screens, the digits, or the cursor position. The "AUTOROLL" function will only be activated when the user depresses the corresponding keys for a certain period of time.

9 Display / Select **Display / Select**

Automatic mode: Display - By pressing this button, one navigates through the display of operating and alarm messages.
Configuration: Select - A jump is made to the next configuration screen. If the value originally displayed has been changed via the "Digit" or "Cursor" push-buttons the newly set value is saved by pressing the "Select" push-button once. By pressing this push-button again, the user causes the system to display the next configuration screen.

10 Digit **Digit**

Automatic mode: Digit - no function
Configuration: Digit - With this push-button, the number at which the cursor is currently located is increased by one digit. The increase is restricted by the admissible limits (see list of parameters included in the appendix). In case the maximum number is reached which can be set, the number automatically returns to the lowest admissible number.

11 Clear / Cursor **Clear..Cursor**

Automatic mode: Clear - By pressing this button, all alarm messages are deleted, provided that they are no longer detected.
Configuration: Cursor - This push-button is used to move the cursor one position to the right. When the last right-hand position is reached, the cursor automatically moves to the first position left-hand of the value to be entered.

LC display

12 LC-Display **LC-Display**

Performance quantities can be retrieved from the two-lines display, provided that the unit is in automatic mode. In configuration mode, the individual parameters are displayed.

Display monitoring in automatic mode: Double voltage / frequency display

LCD type 1 (V configured)

```
1: 000 V 00,00Hz
2: 000 V 00,00Hz
```

Double voltage and double frequency displays

Voltage and frequency of system 1 and system 2 are displayed. The phase angle between the generator and synchronization voltage is displayed by the synchroscope (LED strip).

LCD type 2 (kV configured)

```
1:00,0kV 00,00Hz
2:00,0kV 00,00Hz
```

1.....Voltage and frequency of system 1
2.....Voltage and frequency of system 2

Display monitoring in automatic mode: Alarm indication

```
----------------
xxxxxxxxxxxxxxxx
```

Alarm indication, bottom line

The indications are displayed according to the following list:

Type of alarm	Displayed text
Synchronization time is exceeded	`Synchr. time`

Chapter 6.
Configuration

CAUTION

Please note that configuration only should be done in a standstill of the system.

NOTE

Please note the parameter list at the end of this manual.

While in configuration mode, (simultaneous depression of "Digit" and "Cursor"), the function "Select" causes the input masks to scroll. A long depression of the key "Select" activates the scrolling function, causing a quick scrolling of the indication displays. Please note that a backward scrolling of the last four configuration masks is possible (Exception: Jumping from the first to the last mask is not possible). To do this you must simultaneously press the buttons "Select" and "Cursor". If no entry, modification or any other action is carried out for about 10 minutes, the unit automatically returns to the automatic mode.

Configure basic data

`SPRACHE/LANGUAGE` `english`	**Language selection** — **German/English** The screens (configuration and display screens) can be displayed in either German or English.
`Software version` `x.xxxx`	**Firmware version** Indicates the firmware version currently used.

Password protection

The unit is equipped with a three-level code and configuration hierarchy, which enables it to visualize various configuration screens for different users. A distinction is made between:

- **Code level 0 (CL0) -** User: Third party
  This code level enables no access whatsoever to the parameters. The configuration is blocked.

- **Code level 1 (CL1) -** User: Plant operator
  This code level entitles the user to change a few selected parameters. Changing a code number is not possible in this case.

- **Code level 2 (CL2) -** User: Commissioner
  With code level 2 the user has direct access to all parameters (displaying and changing). In addition, in this level the user may also set the code number for levels 1 and 2 or switch off the password protection.

```
Enter code
number      XXXX
```

Enter code number **0..9999**

On accessing the configuration mode, a code number, which identifies the various users, is requested. The displayed number XXXX is a random number (RN). If the random number has been confirmed with "Select" without being changed, the unit's code level remains. On entering the code number for level 1 respectively level 2, the unit switches into code level CL1 respectively CL2 and the parameters can be changed accordingly. On entering a wrong code number, the unit switches into code level 0.

NOTE

Two hours after entering the code number the code level automatically drops back to CL0!
The default code number for code level 1 (CL1) is "0001"!
The default code number for code level 2 (CL2) is "0002"!
Only in code level 2 the password protection can be switched off!

```
Password
Protection    ON
```

Password protection **ON/OFF**

ON..... Access to configuration is done by entering the relevant code number (code level 1/2). If a wrong code number was entered, the configuration will be blocked.
OFF..... The user has direct access to all parameters, the code number is not requested.

Direct Configuration

NOTE

To carry out direct configuration, you require a direct configuration cable (revision B or higher: part number 5417-557), the LeoPC1 program (supplied with the cable), and the corresponding configuration files. Please consult the online help installed when the program is installed for a description of the LeoPC1 PC program and its setup.

The parameters of the unit can be read via the configuration plug at any time. The parameters can only be altered via direct configuration if the password protection disabled or the unit is in code level 2. If the password protection is enabled and the unit is in code level 0 or 1, the password (code number) for code level 2 must be entered via direct configuration, to modify the parameters. The ability to modify parameters via the display is not affected by the password being entered through LeoPC1.

```
Direct para.
          YES
```

Configuration via the lateral plug **YES/NO**

YES .....Configuration via the configuration plug is enabled. The following further conditions must be met in order to carry out configuration via the configuration plug:
- A connection must be established via the direct configuration cable between the control and the PC
- The baud rate of the LeoPC1 program must be set to 9600 Baud
- The corresponding configuration file must be used (file name: "*.cfg")

NO .....Configuration via the configuration plug is disabled.

Configure basic settings

WARNING

An incorrect input may lead to wrong measuring values and destroy the generator!

```
Rated Frequency
     fn = 00.0Hz
```

Rated system frequency **48.0..62.0 Hz**

Enter the rated frequency of the generator (or the public mains) which in most cases is 50 Hz or 60 Hz.

```
Generator freq.
Setpoint= 00.0Hz
```

Setpoint frequency system 2 **48.0..62.0 Hz**

The setpoint frequency of system 2 is to be entered in this mask. It will be needed for the frequency controller while in no-load operation.

```
Voltage system 1
secondary  000V
```

Secondary voltage system 1 (measuring transducer) **50..440 V**

Secondary voltage of system 1 is set here in V. This entry serves to indicate the primary voltages in the display. In the case of measured voltages of 400 V without a measurement transducer, 400 V must be set here.

```
Voltage system 2
secondary  000V
```

Secondary voltage system 2 (measuring transducer) **50..440 V**

The secondary voltage of system 2 is set here in V. This entry serves to indicate the primary voltages in the display. In the case of measured voltages of 400 V without a measurement transducer, 400 V must be set here.

```
Voltage system 1
primary 00.000kV
```

Primary voltage system 1 (measuring transducer) **0.1..65.0 kV**

The primary voltage of system 1 is set her in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 400 V without a measurement transducer 0.40 kV must be set here.

```
Voltage system 2
primary 00.000kV
```

Primary voltage system 2(measuring transducer) **0.1..65.0 kV**

The primary voltage of system 2 is set here in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 400 V without a measurement transducer, 0.40 kV must be set here.

```
Rated voltage
     Vn = 000V
```

Rated voltage **70..420 V**

This value is used, among other things, to determine the permissible range for the synchronization.

```
Voltage system 2
Setpoint    000V
```

Setpoint voltage of system 2 **50..440 V**

This value of the voltage specifies the setpoint of system 2 voltage for no-load and isolated operation.

Configure controller

Entering the values in the subsequent masks will change the parameters of the controller.

CAUTION

An incorrect entry may lead to uncontrolled actions of the governor and may destroy the automatically regulated generator!

No load control

```
Automatic idle
Running      ON
```

Automatic no-load control **ON/OFF**

ON .....With the power circuit breaker open, frequency and voltage are controlled to the adjusted setpoint values in spite of missing the enable of the controllers (see also chapter "Function tables" on page 21)

OFF .....No-load control is carried out only with controllers released (see also chapter "Function tables" on page 21).

Frequency controller

The SPM-D10B/PSY5-..D.. is equipped with a three-position controller for frequency and does not contain the following masks. Furthermore only the masks for setting the three-position controller are existing. With the extended version SPM-D10B/PSY5-..A.., several controller output signals can be selected via the following screen. In case of the extended version, depending on the selected type of controller, the appropriate screens appear subsequently.

```
f control type
       xxxxxxx
```

only SPM-D10B/PSY5-..A..

Frequency controller type **THREESTEP/ANALOG/PWM**

THREESTEP The frequency controller operates as a three-position controller and outputs higher (f+) and lower pulses (f-) via the according relays. Only one of the two controllers (the frequency or the voltage controller) can be used at a time for the output via the relays. This setting is not possible in units with wide-range power supply (PS5-FU-A-W).

ANALOG .... The frequency controller operates as a continuous controller with an analog output signal (mA or V).

PWM ..... The frequency controller operates as a continuous controller with a pulse-width-modulated output signal and constant level.

Note: The controller setting and the following screens are different, in a way which type of controller will be selected here.

Three-position controller (SPM-D10B/PSY5..D.. and SPM-D10B/PSY5-..A.., Setting 'THREESTEP')

```
Freq. controller
             ON
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Frequency controller **ON/OFF**

ON..... The frequency of system 2 is controlled. The frequency is controlled in various manners depending on the task (no load / isolated operation / synchronization). The subsequent screens of this option are displayed.

OFF..... Control is not carried out, and the subsequent screens of this option are not displayed.

```
Freq. controller
Isol. oper.  ON
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Isolated operation frequency controller **ON/OFF**

ON..... In isolated operation the frequency controller is enabled.

OFF..... In isolated operation the frequency controller is disabled.

```
Freq. Controller
Ramp  = 00.0Hz/s
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Frequency controller setpoint ramp **0.1..99.9 Hz/s**

A change in setpoint is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The more rapidly the change in the setpoint is to be carried out, the greater the value input here must be.

```
Freq. contr.(A)
Dead band=0.00Hz
```

```
Freq. contr.(B)
Dead band=0.00Hz
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Frequency controller insensitivity **0.02..1.00 Hz**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

No load/Isolated operation: The frequency of system 2 is controlled in such a manner that, in its adjusted state, the actual value deviates from the setpoint frequency setting of system 2 (setpoint from mask setting) by the set sensitivity value at most.

Synchronization: The frequency of system 2 is controlled in such a manner that, in its adjusted state, the differential frequency reaches the set sensitivity value at most. The frequency of system 1 is used as the setpoint value and to raise the value of the adjustable difference offset.

```
Freq. contr.(A)
Time pulse>000ms
```

```
Freq. contr.(B)
Time pulse>000ms
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Minimum frequency controller ON period **10..250 ms**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The minimum ON period of the relay should be selected in such a manner that the downstream adjustment facility responds reliably to the pulse that has been set according to the set time. The smallest possible time must be set in order to ensure optimum control behavior.

```
Freq. contr.(A)
Gain Kp     00.0
```

```
Freq. contr.(B)
Gain Kp     00.0
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Frequency controller gain **0.1..99.9**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The gain factor K_p influences the operating time of the relays. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

Analog controller outputs (only SPM-D10B/PSY5-..A.., settings 'ANALOG' and 'PWM')

```
f control output
        xxxxxxx
```

only SPM-D10B/PSY5-..A.. 'ANALOG"

Controller output signal **see table**

This configuration screen only appears, if the frequency controller is configured as ANALOG type! The range of the analog output signal is adjusted here. To choose between a current signal in mA or a voltage signal in V, one has to connect appropriate jumpers to the output terminals. (see chapter Relay outputs" on page 17). The following output signals are possible:

Type	Setting in above configuration screen	Jumper between terminal 8/9	Adjusment range	Adjustment range min.	Adjustment range max.
Current	+/-20mA (+/-10V)	no	+/-20mA	-20 mA	+20 mA
	+/-10mA (+/-5V)		+/-10mA	-10 mA	+10 mA
	0-10mA (0-5V)		0-10mA	0 mA	10 mA
	0-20mA (0-10V)		0-20mA	0 mA	20 mA
	4-20mA		4-20mA	4 mA	20 mA
	10-0mA (5-0V)		10-0mA	10 mA	0 mA
	20-0mA (10-0V)		20-0mA	20 mA	0 mA
	20-4mA		20-4mA	20 mA	4 mA
Voltage	+/-20mA (+/-10V)	ja	+/-10V	-10 Vdc	+10 Vdc
	+/-10mA (+/-5V)		+/-5V	-5 Vdc	+5 Vdc
	+/-3V		+/-3V	-3 Vdc	+3 Vdc
	+/-2.5V		+/-2.5V	-2.5Vdc	+2.5 Vdc
	+/-1V		+/-1V	-1 Vdc	+1 Vdc
	0-10mA (0-5V)		0-5V	0 Vdc	5 Vdc
	0.5V-4.5V		0.5-4.5V	0.5 Vdc	4.5 Vdc
	0-20mA (0-10V)		0-10V	0 Vdc	10 Vdc
	10-0mA (5-0V)		5-0V	5 Vdc	0 Vdc
	4.5V-0.5V		4.5-0.5V	4.5 Vdc	0.5 Vdc
	20-0mA (10-0V)		10-0V	10 Vdc	0 Vdc

```
f control output
Level PWM 00.0V
```

only on SPM-D10B/PSY5-..A.. 'PWM'

Level PWM signal **3.0..10.0 V**

These configuration screen only appears, if the frequency controller is configured as PWM type! The voltage level of the PWM signal is adjusted here.

```
PWM-signal
Logic  positive
```

only on SPM-D10B/PSY5-..A.. 'PWM'

Logic PWM signal **positive / negative**

These configuration screen only appears, if the frequency controller is configured as PWM type!

positive.....If the controller output signal accounts for 100 %, the adjusted PWM level is output permanently, at 0 % the output signal accounts for 0 V.

negative.....If the controller output signal accounts for 100 %, 0 V is output permanently, at 0 % the output signal corresponds to the adjusted PWM level.

```
f control output
Init.state  000%
```

only on SPM-D10B/PSY5-..A.. 'ANALOG' & 'PWM'

Initial frequency controller state **0..100%**

Controller output setting with controller switched off. The setting value in percent relates to the range between the minimal value and the maximal value of the output signal (see below).

```
Freq. controller
            ON
```

nur bei SPM-D10B/PSY5-..A.. 'ANALOG' & 'PWM'

Frequency controller **ON/OFF**

ON.....The frequency of system 2 is controlled. The frequency of system 2 is controlled in various manners depending on the task (no load / isolated operation / synchronization). The subsequent screens of this option are displayed.

OFF.....Control is not carried out and the subsequent screens of this option are not displayed.

```
Freq. controller
Isol. oper.   ON
```

only on SPM-D10B/PSY5-..A.. 'ANALOG' & 'PWM'

Isolated operation frequency controller **ON/OFF**

ON.....In isolated operation the frequency controller is activated.

OFF.....In isolated operation the frequency controller is inactive.

```
Freq. controller
Ramp    00.0Hz/s
```

only on SPM-D10B/PSY5-..A.. 'ANALOG' & 'PWM'

Frequency controller setpoint ramp **0.1..99.9 Hz/s**

A change in setpoint is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The more rapidly the change in the setpoint is to be carried out, the greater the value input here must be.

```
f control output
(max.)      000%
```

only on SPM-D10B/PSY5-..A..
'ANALOG' & 'PWM'

Maximal value frequency controller **0..100%**

Upper limit of the analog controller output.

```
f control output
(min.)      000%
```

only on SPM-D10B/PSY5-..A..
'ANALOG' & 'PWM'

Minimal value frequency controller **0..100%**

Lower limit of the analog controller output.

```
Freq. contr.(A)
Gain Kp      000
```

```
Freq. contr.(B)
Gain Kp      000
```

only on SPM-D10B/PSY5-..A..
'ANALOG' & 'PWM'

P gain of the frequency controller **1..240**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The proportional coefficient specifies the gain (see chapter, "Analog controller outputs" from page 27).

```
Freq. contr.(A)
Reset Tn   00.0s
```

```
Freq. contr.(B)
Reset Tn   00.0s
```

only on SPM-D10B/PSY5-..A..
'ANALOG' & 'PWM'

Reset time load frequency controller **0.0..60.0 s**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The reset time T_n belongs to the I part of the PID controller (see chapter "Analog controller outputs" from page 27).With the setting T_n=0.00 s the Ipart is switched off.

```
Freq. contr.(A)
Derivat.Tv 0.00s
```

```
Freq. contr.(B)
Derivat.Tv 0.00s
```

only on SPM-D10B/PSY5-..A..
'ANALOG' & 'PWM'

Derivative-action time frequency controller **0.00..6.00 s**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The derivative action time T_V belongs to the D part of the PID controller (see chapter "Analog controller outputs" from page 27)) With the setting T_V=0.00 s the D-part is switched off.

Voltage controller

The SPM-D10B/PSY5-..D.. is equipped with a three-position controller for voltage and does not contain the following screen. Furthermore only screens for the setting of the three-position controller are existing. With the extended version SPM-D10B/PSY5-..A.., several controller output signals can be selected via the following screen. In case of the extended version, depending on the selected type of controller, the appropriate screens appear subsequently.

```
V contr. type
       xxxxxxx
```

on SPM-D10B/PSY5-..A..

Voltage controller type **THREESTEP/ANALOG**

THREESTEP The voltage controller operates as a three-position controller and outputs higher (V+) and lower pulses (V-) via the according relays. Only one of the two controllers (the frequency or the voltage controller) can be used at a time for the output via the relays. This setting is not possible in devices with wide-range power supply (SPM-D10B/SPM-D10B/PSY5-FU-A-W).

ANALOG.....The voltage controller operates as a continuous controller with an analog output signal (mA or V).

Note: The controller setting and the following screens are different, in a way which type of controller will be selected here.

Three-position controller (SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.., setting 'THREESTEP')

```
Volt. controller
              ON
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Voltage controller **ON/OFF**

ON.....System 2 voltage control is carried out. The voltage of system 2 is controlled in various manners depending on the task (no load / isolated operation / synchronization). The subsequent screens of this option are displayed.

OFF.....Control is not carried out, and the subsequent screens of this option are not displayed.

```
Volt. controller
Isol. oper.  ON
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Voltage controller isolated mode **ON/OFF**

ON.....In isolated operation the voltage controller is activated.

OFF.....In isolated operation the voltage controller is inactive.

```
Volt. controller
Ramp     = 00V/s
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Voltage controller setpoint ramp **1..99 V/s**

A change in setpoint is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The more rapidly the change in the setpoint is to be carried out, the greater the value input here must be.


```
Volt. contr.(A)
Dead band 00.0V
```

```
Volt. contr.(B)
Dead band 00.0V
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Voltage controller insensitivity **0.5..60.0 V**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

No load/Isolated operation: The voltage is controlled in such a manner that, in its adjusted state, the actual value deviates from the setpoint voltage setting (setpoint from mask setting) by the set sensitivity value at most.

Synchronization: The voltage of system 2 is controlled in such a manner that, in its adjusted state, the differential voltage reaches the set sensitivity value at most. The voltage of system 1 is used as the setpoint value.

```
Volt. contr.(A)
Time pulse>000ms
```

```
Volt. contr.(B)
Time pulse>000ms
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Minimum voltage controller ON period **20..250 ms**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The minimum ON period of the relay should be selected in such a manner that the downstream adjustment facility responds reliably to the pulse that has been set according to the set time. The smallest possible time must be set in order to ensure optimum control behavior.

```
Volt. contr.(A)
Gain Kp     00.0
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

```
Volt. contr.(B)
Gain Kp     00.0
```

on SPM-D10B/PSY5-..D.. and SPM-D10B/PSY5-..A.. 'THREESTEP'

Voltage controller gain factor **0.1..99.9**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The gain factor K_p influences the operating time of the relays. By increasing the factor, the operating time can be increased in the event of a certain control deviation.

Analog controller outputs (only SPM-D10B/PSY5-..A.., setting 'ANALOG')

```
V control output
        xxxxxxx
```

only on SPM-D10B/PSY5-..A.. 'ANALOG'

Controller output signal **see table**

This configuration screen only appears, if the voltage controller is configured as ANALOG type!
The range of the analog output signal is adjusted here. To choose between a current signal in mA or a voltage signal in V, one has to connect appropriate jumpers to the output terminals. (see chapter Relay outputs on page 17).
The following output signals are possible:

Type	Setting in above configuration screen	Jumper between terminal 11/12	Adjustment range	Adjustment range min.	Adjustment range max.
Current	+/-20mA (+/-10V)	no	+/-20mA	-20 mA	+20 mA
	+/-10mA (+/-5V)		+/-10mA	-10 mA	+10 mA
	0-10mA (0-5V)		0-10mA	0 mA	10 mA
	0-20mA (0-10V)		0-20mA	0 mA	20 mA
	4-20mA		4-20mA	4 mA	20 mA
	10-0mA (5-0V)		10-0mA	10 mA	0 mA
	20-0mA (10-0V)		20-0mA	20 mA	0 mA
	20-4mA		20-4mA	20 mA	4 mA
Voltage	+/-20mA (+/-10V)	yes	+/-10V	-10 Vdc	+10 Vdc
	+/-10mA (+/-5V)		+/-5V	-5 Vdc	+5 Vdc
	+/-3V		+/-3V	-3 Vdc	+3 Vdc
	+/-2.5V		+/-2.5V	-2.5Vdc	+2.5 Vdc
	+/-1V		+/-1V	-1 Vdc	+1 Vdc
	0-10mA (0-5V)		0-5V	0 Vdc	5 Vdc
	0.5V-4.5V		0.5-4.5V	0.5 Vdc	4.5 Vdc
	0-20mA (0-10V)		0-10V	0 Vdc	10 Vdc
	10-0mA (5-0V)		5-0V	5 Vdc	0 Vdc
	4.5V-0.5V		4.5-0.5V	4.5 Vdc	0.5 Vdc
	20-0mA (10-0V)		10-0V	10 Vdc	0 Vdc

```
V control output
Init.state  000%
```

only on SPM-D10B/PSY5-..A..
'ANALOG'

Initial voltage controller state **0..100%**

Controller output setting with controller switched off. The setting value in percent relates to the range between the minimal value and the maximal value of the output signal (see below).

```
Volt. controller
           ON
```

only on SPM-D10B/PSY5-..A..
'ANALOG'

Voltage controller **ON/OFF**

ON..... System 2 voltage control is carried out. The voltage of system 2 is controlled in various manners depending on the task (no load / isolated operation / synchronization). The subsequent screens of this option are displayed.
OFF..... Control is not carried out, and the subsequent screens of this option are not displayed.

```
Volt. controller
Isol. oper.  ON
```

only on 'SPM-D10B/PSY5-..A.. '
'ANALOG'

Voltage controller isolated mode **ON/OFF**

ON..... In isolated operation the voltage controller is activated.
OFF..... In isolated operation the voltage controller is inactive.

```
Volt. Controller
Ramp     = 00V/s
```

only on 'SPM-D10B/PSY5-..A..'
'ANALOG'

Voltage controller setpoint ramp **1..99 V/s**

A change in setpoint is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The more rapidly the change in the setpoint is to be carried out, the greater the value input here must be.

```
V control output
(max.)      000%
```

only on 'SPM-D10B/PSY5-..A..'
'ANALOG'

Maximal value voltage controller **0..100 %**

Upper limit of the analog controller output.

```
V control output
(min.)      000%
```

only on 'SPM-D10B/PSY5-..A..'
'ANALOG'

Minimal value voltage controller **0..100 %**

Lower limit of the analog controller output.

```
Volt. contr.(A)
Gain Kp      000
```

```
Volt. contr.(B)
Gain Kp      000
```

only on 'SPM-D10B/PSY5-..A..'
'ANALOG'

P-gain voltage controller **1..240**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The proportional coefficient specifies the gain (see chapter, "Analog controller outputs" from page 27).

```
Volt. contr.(A)
Reset Tn   00.0s
```

```
Volt. contr.(B)
Reset Tn   00.0s
```

only on 'SPM-D10B/PSY5-..A..'
'ANALOG'

Voltage controller reset time **0.0..60.0 s**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The reset time T_n belongs to the I part of the PID controller (see chapter, "Analog controller outputs" from page 27). With the setting T_n=0.00 s the I part is switched off.

```
Volt. contr.(A)
Derivat.Tv=0.00s
```

```
Volt. contr.(B)
Derivat.Tv=0.00s
```

only on 'SPM-D10B/PSY5-..A..'
'ANALOG'

Derivative-action time voltage controller **0.00..6.00 s**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

The derivative-action time T_V belongs to the D part of the PID controller (see chapter "Analog controller outputs" from page 27).). With the setting T_v=0.00 s the D-part is switched off.

Synchronization

```
Synchronizing
functions   ON
```

Synchronization functions **ON/OFF**

ON..... An adaptation of the frequency and voltage of system 2 to the values of system 1 (respectively mains values) is carried out and a connect command is output. The subsequent screens of this option are displayed.

OFF..... No synchronization occurs, but no-load control if necessary. No connect command is output. The subsequent screens of this option are not displayed.

```
Synchocheck-
mode        ON
```

Synch check mode **ON / OFF**

ON..... In this state the device works as a pure synchro check unit. No regulation occurs (see chapter "Operating conditions" on page 24).

OFF..... The device does not work as a synchronizing control, but as a synchronizing unit with controllers.

```
Synchronization
df offs.= 0.00Hz
```

Offset frequency **0.02..0.25 Hz**

During synchronization the setpoint value of the frequency of the system 2 is calculated out of the frequency of system 1 added by this offset. This offset should be at least 0.1 Hz smaller or half the value of dfmax (next parameter). Please also note the setting of the insensitivity of the controller, too.

```
Synchronization
 df max = 0.00Hz
```

Max. perm. differential frequency (pos. slip) **0.02..0.49 Hz**

The prerequisite of a connect command's being output is negative deviation from this set differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip → system 2 frequency is greater than system 1 frequency).

```
Synchronization
 df min =-0.00Hz
```

Max. perm. differential frequency (neg. slip) **0.00..-0.49 Hz**

The prerequisite of a connect command's being output is positive deviation from this set differential frequency. This value specifies the lower frequency (negative value corresponds to negative slip → system 2 frequency is less than the system 1 frequency).

```
Synchronization
 dV max  =  00%
```

Max. perm. differential voltage **0.1..15.0 %**

To ensure that a connect command will be issued, the actual value must fall below the entered differential voltage.

```
Synchronization
Brk.hold T>0.00s
```

Min. pulse duration of connect relay **0.04..0.50 s**

The duration of the connect impulse can be adjusted to the subordinate switching unit.

```
Phase matching
          ON
```

Phase-angle-zero-control **ON / OFF**

ON .....The synchronization is carried out with phase-angle-zero-control and the switching of the power circuit breaker is done dependent of the phase angle [see chapter "Connection with zero phase control"]. In the following, the screens for adjusting the phase-angle-zero-control appear.

OFF .....The synchronization is carried out on frequency and voltage of system 1 and closing the contacts of the power circuit breaker is done in the synchronous point [see chapter "Connection with slip"]. In the following, the screens for adjusting the slip synchronization appear.

```
Slip synchroniz.
Max phase < 00°
```

Zero phase control = OFF

Max. perm. differential angle **0..60°**

This configuration screen only appears, if the phase-angle-zero-control is switched off! The prerequisite of a connect command's being output is negative deviation from this set differential angle.

Synchronization with slip - In the operation mode "synchronization with slip" this angle is only used as an additional criterion. If this criterion shall not take effect, one has to set the angle to 60° here.

In the operation

Synchro check - In the operation mode "Synchro check" the negative deviation from this angle is obligatory for picking up the relay "Close CB".

```
Slip synch.(A)
TClose  CB=000ms
```

```
Slip synch.(B)
TClose  CB=000ms
```

Zero phase control = OFF

Inherent delay of circuit breaker **40..300 ms**

For this parameter two values are adjustable. The parameter value A is active, if the discrete input at terminal 6 is not set or not mounted. The parameter value B is active, if the discrete input at terminal 6 is set.

This configuration screen only appears, if the phase-angle-zero-control is switched OFF! The closing time of the power circuit breaker corresponds to the lead time of the connect command. The connect command will be issued at the entered time before the synchronization point.

```
Phase matching
Max phase < 00°
```

Zero phase control = ON

Max. perm. differential angle in case of phase-angle-zero-control **0..60°**

This configuration screen only appears, if the phase-angle-zero-control is switched on! The angle between the voltages of system 2 and system 1 must be less than the value adjusted here, so that a connect command is output..

```
Phase matching
Dwell time 00.0s
```

Zero phase control = ON

Dwell time for switching in case of phase-angle-zero-control **0.2..10.0 s**

This configuration screen only appears, if the phase-angle-zero-control is switched on! When the maximal permitted differential angle is undershot, a time counter is started and only after the expiry of the dwell time a connection pulse is output. The time counter will be reset, if one of the conditions, which are necessary for the switching, should not be met.


```
Phase matching
Gain          00
```

Zero phase control = ON

Phase-angle-zero-control gain **1..36**

This configuration screen only appears, if the phase-angle-zero-control is switched on! When phase-angle-zero-control is active, this gain determines, how much the output signal is changed depending on phase difference. It must be pointed out, that the frequency controller is also active during a phase-angle-zero-control and has to be adjusted accurately first, before this gain is adapted.

```
Phase matching
df start  0.00Hz
```

Zero phase control = ON

Differential frequency for starting phase-angle-zero-control **0.02..0.25 Hz**

This configuration screen only appears, if the phase-angle-zero-control is switched on! The phase-angle-zero-control is activated, when the differential frequency between system 2 and system 1 undershoots the value adjusted here.

Synchronization time monitoring

```
Sync.time contr.
Alarm         ON
```

Synchronization time monitoring **ON/OFF**

ON..... This setting ensures that the synchronization time will be monitored. A time counter starts simultaneously with the beginning of the synchronization. If, following the expiry of the set time, the power circuit breaker has not been activated, a warning message "Synchronization time" is output. Moreover, the synchronization procedure will be cancelled and the relay "readiness for operation" drops out. By pressing the button "Clear" for at least 3 seconds or by removing one of the conditions, which are necessary for the synchronization (e.g. terminal 3 "Release CB"), the watchdog is reset. The subsequent screens of this option are displayed.

OFF..... The synchronization time will not be monitored. The subsequent screens of this option are not displayed.

```
Sync.time contr.
Delay time 000s
```

Final value for synchronization time monitoring **10..999 s**

Please refer to the above description of the configuration screen.

Black start

```
Black start
          ON
```

Blackstart **ON/OFF**

ON .....Release of all black start functions. The subsequent screens of this option are displayed.
OFF .....No black start is carried out, and the subsequent screens of this option are not displayed.

```
Black start
U1=O/U2=O   ON
```

Black start function 1: U1=U2=0 **ON/OFF**

Release of the black start function 1. In this case, both systems, U1 and U2, must fall below an adjustable threshold value in order to enable the output of an add-on order (dead bus-dead line).

```
Black start
U1=O/U2=Un   ON
```

Black start function 2: U1=0, U2=Un **ON/OFF**

Release of the black start function 2. In this case, the approximate value of the voltage of system U1 must be zero, and the voltage of system U2 must be applied (dead line-live bus).

```
Black start
U1=Un/U2=O   ON
```

Black start function 3: U1=Un, U2=0 **ON/OFF**

Release of the black start function 3. In this case, the approximate value of the voltage of system U2 must be zero and the voltage of system U1 must be applied (live bus-dead line).

```
Black start
     Tmin > 00s
```

Min. monitoring time of the black start conditions **0..20 s**

Before a black start can be carried out, all conditions for the add-on of the power circuit breaker must be at least maintained for the pre-set time.

```
Black start
dV |V-O| < 00%
```

Max. adm. zero voltage diff. for switching to the black busbar **3..50 %**

To ensure that the value of a voltage is detected as "approximate zero" the maximum deviation from zero must not exceed the pre-set value (referring to the rated voltage) .

```
Black start
dV |V-Vn| < 00%
```

Mini. rated voltage diff. for switching to the black busbar **1..20 %**

To ensure that a voltage is detected as "applied", the deviation from the rated voltage must not exceed the pre-set value.

```
Black start
df max = 0.00Hz
```

Max. rated voltage diff. for switching to the black busbar **0.05..5.00 Hz**

To make sure that the power circuit breaker will be closed, the deviation of the frequency of the voltage-carrying system from the rated frequency must not exceed the differential frequency pre-set .

Relay output 16-17

" Message: Connect 2"
Terminal 16/17

The method of functioning of the relay "Message: Connect 2" depends on the setting of the mask "Rel. connect 2".

```
Rel. "connect 2"
xxxxxxxxxxxxxxx
```

Relay function connect 2 **OFF /asynch.only/ synchr. only/ syn/asyn.**

For the relay "Message: Connect 2" the following setting options are possible:

OFF..... The relay " Message: Connect 2" is not active.

Black start only The relay " Message: Connect 2" **only** switches simultaneously with relay "Command: Close CB" (terminal 14/15), if the add-on order is released due to the detection of a black start condition. With this setting, the relay can bridge a contact of a synch-check relay which is externally connected in series with the add-on order (terminal 14/15). Thus, a two-channel relay control is possible during synchronization, but also an add-on order in case of a dead busbar.

Synchronous only The relay " Message: Connect 2" **only** switches simultaneously with the relay "Command: close CB" (terminal 14/15), if the add-on order is released due to the detection of the synchronism. With this setting, a second output is possible with the relay, which will not respond in case of a black start.

Black/synchron. The relay " Message: Connect 2" always switches simultaneously with the relay "Command: close CB" (terminal 14/15). With this setting, a second output is possible with the relay, which is completely identical with the relay "Command: close CB " (terminal 14/15). If a single-channel system is used for a two-terminal control of the circuit breaker, this relay can be used for the switching of the second terminal. Please note that this second contact assembly cannot be used as a substitute for a synch-check relay!

Password configuration

NOTE

Once the code level is set, this is not changed, even if the configuration mode is accessed steady. If an incorrect code number is input, the code level is set to CL0, and the item is thereby blocked for third parties.

If the supply voltage is present, uninterrupted, at the item for 2 hours, code level 0 is automatically set.

--

Code level 1 (Customer) **0..9999**

```
Define level 1
code         0000
```

This screen first appears in code level 2 (password protection active). Following the input of digits in this screen, the code level for level 1 (Customer) is set. More information to password protection see on page 37.

Code level 2 (Commissioner) **0..9999**

```
Define level 2
code         0000
```

This screen first appears in code level 2 (password protection active). Following the input of digits in this screen, the code level for level 2 (mechanic) is set. More information to password protection see on page 37.

Chapter 7.
Commissioning

DANGER - HIGH VOLTAGE

When commissioning the unit, please observe the five safety rules that apply to the handling of live equipment. Make sure that you know how to provide first aid in current-related accidents and that you know where the first aid kit and the nearest telephone are. Never touch any live components of the system or on the back of the system:

L I F E T H R E A T E N I N G

CAUTION

The unit may only be commissioned by a qualified technician. The "EMERGENCY STOP function must function safely before the commissioning and must not depend on the particular engine.

CAUTION

Prior to commissioning, check that all measuring voltages are correctly connected with regard to phases. The connect commands for the power circuit breakers must be disconnected at the power circuit breakers. The rotating field must be measured. Any lack or incorrect connection of measuring voltages or other signals may lead to incorrect functions and damage the unit as well as engines and components connected to the unit!

Procedure

1. Disconnect the add-on orders directly at the power circuit breakers.

2. After checking if all measuring voltages are connected in-phase, the power supply has to be applied (24 Vdc) .

3. By simultaneous depression of the two buttons "Digit" and "Cursor" you enter into configuration mode.

4. Enter the parameters following the sequence of the different masks. The setting limits can be either read from the description of the masks or from the list of parameters at the end of the operating manual.

5. Do not enable any function (breaker or control) and ensure that all displayed values are correct (are the same as measured with an separate measuring device). **If a measuring voltage has been wired incorrect or not at all, this may lead to an asynchronous add-on order in case of an active black start!**

6. Check the status of all control and auxiliary inputs and the appropriate LEDs on the front foil of the unit. Check the status of all control and auxiliary outputs as well as the setting of the controller outputs.

7. Synchronizing the power circuit breaker:
   a) Disconnect the connection to the power circuit breaker;
   b) the voltage to which the system has to be synchronize to, must be within the admissible range;
   c) the signal "Enable CB" has to be applied.
   e) If the generator voltage is 50 % lower that the rated value the frequency controllers starts to operate. Set parameters of the controller in that way that the setpoint value is controlled at an optimum.
   f) Prior to the automatic closing of the circuit breaker ensure that all measuring values have been wired and applied correct. In the synchronous point check weather the synchronizing functions have been configured correctly. This test is best done using a differential voltage meter direct at the power circuit breaker.

8. Black start
   a) Disconnect the connection to the power circuit breaker.
   b) Check all conditions and measuring voltages and test the add-on command.
   c) Automatically switching of the power circuit breaker.

9. After successful closing of the power circuit breaker the LED "Closed" has to light up.

Appendix A.
Dimensions

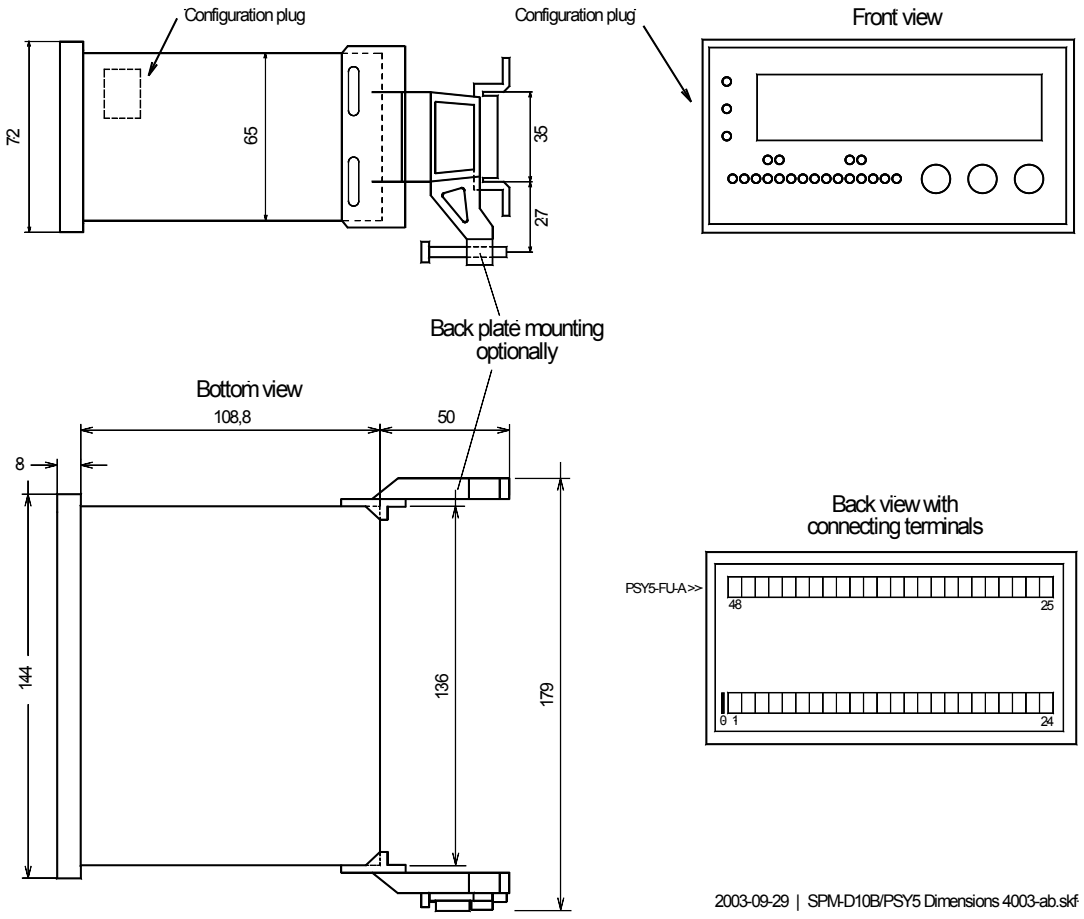

Figure 7-1: Dimensions

Appendix B.
List of Parameters

Product number P/N _____ Rev _____

Version SPM-D10B/PSY5 _____

Project _____

Serial number S/N _____ Date _____

Option	Parameter 100/400V; 1/5 A	Adjustment range	Standard setting	Customer settings	
CONFIGURE GENERAL PARAMETERS					
	SPRACHE/LANGUAGE	German/Englisch	English	☐ G ☐ E	☐ G ☐ E
	Softwareversion		1.1xx		
	Enter code number	0..9.999	XXXX		
	Password Protection	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Direct para.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
CONFIGURE BASIC SETTINGS					
	Rated Frequency fn	48.0..62.0 Hz	50.0 Hz		
	Generator freq. Setpoint	48.0..62.0 Hz	50.0 Hz		
	Voltage system 1 secondary	50..440 V	400 V		
	Voltage system 2 secondary	50..440 V	400 V		
	Voltage system 1 primary	0.1..65.0 kV	0.4 kV		
	Voltage system 2 primary	0.1..65.0 kV	0.4 kV		
	Rated voltage Vn	70..420 V	400 V		
	Voltage system 2 Setpoint	50..440 V	400 V		
CONFIGURE CONTROLLER					
	Automatic idle Running	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	f control type	THREEP/ANA./PWM	ANALOG		
	Freq. controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Freq. controller Isol. oper	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Freq. Controller Ramp	0.1..99.9 Hz/s	5.0 Hz/s		
A	Freq. contr.(A) Dead band	0.02..1.00 Hz	0.10 Hz		
..	Freq. contr.(A) Time pulse>	10..250 ms	80 ms		
A	Freq. contr.(A) Gain Kp	0.1..99.9	5.0		
B	Freq. contr.(B) Dead band	0.02..1.00 Hz	0.10 Hz		
..	Freq. contr.(B) Time pulse>	10..250 ms	80 ms		
B	Freq. contr.(B) Gain Kp	0.1..99.9	30.0		
	f control output	see table	+/-20 mA (+/-10 V)		
	f control output Level PWM	3.0..10.0 V	10.0 V		
	PWM-signal Logic positive	positive/negative	positive		
	f control output Init.state	0..100 %	50 %		
	f control output (max.)	0..100 %	100 %		
	f control output (min.)	0..100 %	0 %		
A	Freq. contr.(A) Gain Kp	1..240	15		
..	Freq. contr.(A) Reset Tn	0.0..60.0 s	2.5 s		
A	Freq. contr.(A) Derivat.Tv	0.00..6.00 s	0.00 s		
B	Freq. contr.(B) Gain Kp	1..240	15		
..	Freq. contr.(B) Reset Tn	0.0..60.0 s	2.5 s		
B	Freq. contr.(B) Derivat.Tv	0.00..6.00 s	0.00 s		

Option	Parameter 100/400V; 1/5 A	Adjustment range	Standard setting	Customer settings	
	V contr. type	THREESTEP/ANALOG	ANALOG		
	Volt. controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Volt. controllerIsol. oper.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Volt. controller Ramp	1..99 V/s	25 V/s		
A	Volt. contr.(A) Dead band	0.1..25.0 %	0.5 %		
..	Volt. contr.(A) Time pulse>	20..250 ms	80 ms		
A	Volt. contr.(A) Gain Kp	0.1..99.9	5.0		
B	Volt. contr.(B) Dead band	0.1..25.0 %	0.5 %		
..	Volt. contr.(B) Time pulse>	20..250 ms	80 ms		
B	Volt. contr.(B) Gain Kp	0.1..99.9	30.0		
	V control output	see table	+/-20 mA (+/-10 V)		
	V control outputInit.state.	0..100 %	50 %		
	V control output (max.)	0..100 %	100 %		
	V control output (min.)	0..100 %	0 %		
A	Volt. contr.(A) Gain Kp	1..240	15		
..	Volt. contr.(A) Reset Tn	0.0..60.0 s	2.5 s		
A	Volt. contr.(A) Derivat.Tv	0.00..6.00 s	0.00 s		
B	Volt. contr.(B) Gain Kp	1..240	15		
..	Volt. contr.(B) Reset Tn	0.0..60.0 s	2.5 s		
B	Volt. contr.(B) Derivat.Tv	0.00..6.00 s	0.00 s		
CONFIGURE SYNCHRONIZATION					
	Synchronizing functions	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Synchrocheck- mode	ON/OFF	OFF		
	Synchronization df offs.=	0.02..0.25 Hz	0.10 Hz		
	Synchronization df max	0.02..0.49 Hz	0.18 Hz		
	Synchronization df min	0.00..-0.49 Hz	-0.10 Hz		
	Synchronization dV max	0.1..15.0 %	6 %		
	Synchronization Brk.hold T>	0.04..0.50 s	0.20 s		
	Phase matching	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Slip synchroniz. Max.phase<	0..60°	7 °		
A	Slip synch.(A) TClose CB	40..300 ms	80 ms		
B	Slip synch.(B) TClose CB	40..300 ms	80 ms		
	Phase matching Max phase <	0..60 °	7 °		
	Phase matching Dwell time	0.2..10.0 s	10.0 s		
	Phase matching Gain	1..36	2		
	Phase matching df start	0.02..0.25 Hz	0.20 Hz		
CONFIGURE SYNCH TIME MONITORING					
	Sync.time contr. Alarm	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Synch.Zeitüberw. Delay time	10..999 s	120 s		
CONFIGURE BLACK START					
	Black start	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Black start U1=O/U2=O	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Black start U1=O/U2=Un	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Black start U1=Un/U2=O	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Black start Tmin >	0..20 s	5 s		
	Black start dV |V-O| <	3..50 %	10 %		
	Black start dV |V-Vn| <	1..20 %	5 %		
	Black start df max =	0.05..5.00 Hz	0.25 Hz		
	Rel.connect 2	OFF / only asyn. / only syn. / syn/asyn.	OFF		
CONFIGURE PASSWORD					
	Define level 1 code	0000..9999	0001		
	Define level 2 code	0000..9999	0002		

Appendix C.
Technical Data

Measuring voltage ----------

- Measuring voltage — Standard (U_N) ⅄/Δ ..... 230/400 Vac
  Measuring range ..... 50..400 Vac
- Measuring frequency ..... 40.0..70.0 Hz
- Accuracy ..... Class 1
- Resistance ..... 0.1 %
- Continuous voltage input ..... 1.3 × U_N
- Input resistance ..... 0.696 MΩ
- Maximum power consumption per path ..... 0.15 W

Ambient variables ----------

Power supply — Standard ..... 24 Vdc (+/-25 %)
SPM-D10B/PSY5-..W ..... 90..250 Vac
Intrinsic consumption — Standard ..... max. 10 W
SPM-D10B/PSY5-..W max. 10 W (10 VA oder 10 W)

- Ambient temperature ..... -20..+70 °C
- Ambient humidity ..... 95 %, not condensing

Discrete inputs ---------- **isolated**

- Input range ($U_{Cont, digital input}$) ..... 18..250 Vac/dc
- Input resistance ..... ca. 68 kΩ

Relay outputs ---------- **isolated**

- Make contact ..... potential free
- Contact material ..... AgCdO
- General purpose (GP) ($U_{Cont, relay output}$)
  AC ..... 2.00 Aac@250 Vac
  DC ..... 2.00 Adc@24 Vdc
  0.36 Adc@125 Vdc
  0.18 Adc@250 Vdc
- Pilot duty (PD) ($U_{Cont, relay output}$)
  AC ..... 1.00Aac@250 Vac B300
  DC ..... 1.00 Adc@24 Vdc
  0.22 Adc@125 Vdc
  0.10 Adc@250 Vdc

Analog outputs (SPM-D10B/PSY5-..-A-..) ---------- **isolated**

- Insulation voltage ..... 1,500 Vdc
- Resolution ..... 10 bit
- Output 0/4..20 mA, max. load ..... 500 Ohm
- Output 0..10 Vdc, internal resistance ..... 500 Ohm

Housing ----------

- Type ..... APRANORM DIN 43 700
- Dimensions (W × B × H) ..... 144 × 72 × 122 mm
- Front cutout (W×H) ..... 138 [+1.0] × 68 [+0.7] mm

- Wiring ..... Screw-type terminals depending on plug connector 1.5 mm² or 2.5 mm²
  use 60/75 °C copper wire only
  use class 1 wire only or equivalent
- Weight ..... approx. 800 g

Protection----------

- Protection system ..... IP42 from front at professional installation
  IP54 from front with gasket
  IP20 from back
- Front foil ..... insulating surface
- EMV test (CE) ..... tested according to applicable EN guidelines
- Listings ..... CE marking

Appendix D.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed. If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

Returning Equipment For Repair

If a control (or any part of an electronic control) is to be returned to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the unit(s), attach a tag with the following information:

- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part numbers (P/N) and serial number (S/N);
- description of the problem;
- instructions describing the desired type of repair.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules.*

Packing A Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

Return Authorization Number RAN

When returning equipment to Woodward, please telephone and ask for the Customer Service Department in Stuttgart [+49 (0) 711 789 54-510]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number, and arrange for issue of a purchase order for the unit(s) to be repaired. No work can be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at +49 (0) 711 789 54-510 for instructions and for a Return Authorization Number.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part numbers P/N (XXXX-XXX) that is on the enclosure nameplate;
- the unit serial number S/N, which is also on the nameplate.

How To Contact Woodward

Please contact following address if you have questions or if you want to send a product for repair:

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-510 (8.00 - 16.30 German time)
Fax: +49 (0) 711 789 54-101
e-mail: stgt-info@woodward.com

For assistance outside Germany, call one of the following international Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com**) for the name of your nearest Woodward distributor or service facility. [For worldwide directory information, go to **www.woodward.com/ic/locations**.]

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by e-mail, or through the Woodward website.

- Technical support
- Product training
- Field service during commissioning

Technical Support is available through our many worldwide locations, or through our authorized distributors depending on the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical engineering support, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference technical support.

Product Training is available on-site from several of our worldwide facilities, or at your location, depending on the product. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability. For information concerning training, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***customer training***.

Field Service engineering on-site support is available, depending on the product and location, from our facilitys, or from one of many worldwide Woodward offices or authorized distributors. Field engineers are experienced on both Woodward products as well as on much of the non-Woodward equipment with which our products interface. For field service engineering assistance, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***field service***.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Contact

Your company _____

Your name _____

Phone number _____

Fax number _____

Control (see name plate)

Unit no. and revision: P/N: _____ REV: _____

Unit type easYgen- _____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available. You can print this using ToolKit. Additionally you can save the complete set of parameters (standard values) and send them to our Service department via e-mail.

We appreciate your comments about the content of our publications.

Please send comments to: stgt-documentation@woodward.com

Please include the manual number from the front cover of this publication.

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Homepage

http://www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address/phone/fax/e-mail information for all locations is available on our website (www.woodward.com).

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